TOP FY 2000
Project Narrative

Marshall University Research Corporation

Grant # 54-60-00031
Huntington, WV

Project Purpose

The *CrossRoads - 2000* project can be described as something like the traditional highway intersection. The community that develops where the paths of two or more forms of transportation cross provides the metaphor for this project. However, the “information highway” of information and data provides one form of transportation here. In this approach, the intersection of the “information highway” with the physical path takes place in 2 high schools, and a union training hall. In this design, a coordinator or facilitator takes the physical place of the teacher and the function of the teacher moves to remote sites. Like the historic small community, this project will help create: (1) a feeling of integration and connection to the community, (2) a feeling of community and family where "older" students help "younger" students, (3) a self-contained, remote facility that provides a quality education and brings the world to the community, and (4) a self-paced atmosphere of cooperation and community, but it will use state-of-the-art technology to do so in a depth never imagined by our pedagogical ancestors.

The main purpose of this project is to demonstrate an alternative to the delivery of traditional synchronous classroom instruction and associated face-to-face advising, assistance, counseling, and mentoring, to a wide variety of individuals in a cost-effective, easily supportable and off-the-shelf manner. This new paradigm will deliver high quality instruction, information and services equivalent or superior to the traditional campus and classroom environment to individual learners regardless of their situation. Motivated learners who are disadvantaged in some manner--place bound, low income, remote, or unable to participate in traditional instruction due to employment or other time constraints--can be accommodated. A secondary, but equally important, purpose is the development of a paradigm that is adaptable to a variety of information needs. For example, improved access to information on health care, public service, public safety, culture, and avocation, as well as access to communities of interest can be made in the same cost-effective manner by integrating easily available components.

Definition of the Problem

The West Virginia college-going rate is the lowest in the nation. West Virginia ranks fiftieth among the states in the preparation of its workforce for the new economy. West Virginia ranks forty-seventh in the nation in the proportion of its adult population at the lowest levels of literacy. In January 2000 the state had the lowest January unemployment rate in 40 years but at 5.6% (seasonal adjusted) still exceeded the national average of 4.0% (seasonal adjusted). The leading variables contributing to the problem are cost and access of education, information, and training. Technology can improve this situation, but only if it is affordable, available, and easy to use. The disadvantages of low income, distance, cultural and language barriers make it almost impossible for many individuals to access the education they must have in order to reach their full potential in today’s world.

The concept of "traditional education" followed by "Lifelong Learning” is not available to many. The path to traditional higher education has substantial inequities in access to information and knowledge for disadvantaged populations, particularly in specialized fields and in poor or remote

areas. Attempts to access lifelong learning are not only similarly plagued with inequities, but also are complicated by the disadvantages of a time-bound job or life situation. In addition, it is more evident that the acquisition of the traditional K-12 or vocational education is threatened by similar restrictions. Too often, life and family obligations will not allow for attendance of not only extracurricular or enrichment programs but also, in some cases, the traditional classes themselves.

Additionally, a wide variety of information and knowledge exists outside the traditional educational environment that, if made easily available, could improve the quality of life for most individuals and families. Unfortunately, access to these resources is similarly limited, expensive, and difficult notwithstanding the various commonly identified disadvantages. Technology and the information highway can improve access, lower barriers, and lessen the impact of disadvantages, but only if individuals are not likewise "technologically disadvantaged" by inadequate availability, affordability, and ease of use.

A key technical barrier to the growth of the information industry is the limited capacity of existing networks, many of which cannot carry large amounts of digital video. New technology is needed to increase network capacity, while also reducing video transport costs. Universal access and low cost would be promoted if video could be delivered to personal computers (PCS), which are used by more than 100 million people worldwide, and in many cases already are connected to networks. The computer, telecommunications, and video technologies are converging rapidly, and the resulting multimedia applications are expected to transform the way many academic and community partners operate, while enhancing productivity and quality of life. However, the convergence is being hindered by technical barriers, including a proliferation of different standards and a lack of demonstration of data and video applications at different bandwidths.

Proposed Solution

The consortium’s solution consists of an integration of off-the-shelf and a few custom products into a system - the *CrossRoads–2000* "learning cluster." The learning cluster provides access to flexible, high-quality instruction, information, and interaction. The *CrossRoads–2000* cluster of client workstations and servers attaches to an ATM network. Also connected to the network are information nodes such as the Marshall University Drinko Library (see Appendix 3 for description), and an Internet gateway. An information node is the repository for courseware, video, multimedia materials, and related information servers.

The proposal will enable the Marshall University Drinko Library to serve as the principal information node for the initial development, trial and production stages and will place the CrossRoads - 2000 in several settings – two rural two high schools and a rural union training hall. These clusters will be connected to the **Bell Atlantic® WEST VIRGINIA 2001℠** ATM network.

Courses have been and are being restructured to take advantage of alternative methods of delivery and new ways of accessing information, while fostering collaborative learning and promoting interdisciplinary thinking. Support for this innovative teaching and learning

environment comes from throughout the university and all partnering locations. Marshall University's new fully integrated library automation system (VTLS Virtua), external connections, CD-ROM and electronic delivery of documents will expand our library resources to all locations. Network connections with the community offer communication, research, and distance learning opportunities. This environment will also allow us to test this environment across county borders as county school systems seek more efficient and economical methods to deliver "specialty" education.

CrossRoads—2000 provides an environment with a multiplicity of uses, but is principally designed for the individual to interact with the Internet, courseware, peers, mentors, service providers, and instructors. *CrossRoads--2000* is essentially a group of client workstations and a group teleconference system interconnected by a local LAN to dedicated servers providing voice, video, and data to the desktop. As such, it could be used for synchronous classroom instruction either locally or from a distance, or as a traditional two-way videoconference facility. The power of this configuration, however, is the ability of each client workstation to provide a learning environment for an individual when the individual is available. The client software environment proposed is a simplified interface consisting of off-the-shelf browser technology, augmented with custom software providing the transparent behind-the-scenes processing that is required to simplify client use. In this manner, the training and support issues should be minimized and by adding ID technology security and privacy is enhanced.

Techniques we expect to see include group work on problems of guided design and inquiry using the Internet extensively; digitized taped lectures, video on demand and other prepackaged study materials, as well as some "just in time teaching"; e-mail supporting collaborative learning and coaching; and intense student-faculty, student-student, student-expert interaction. This approach to teaching is expected to improve outcomes, extend access, and control costs. We do not expect faculty to do one thing to improve quality, something different to improve access, and a third thing to control costs.

Expected Outcomes

CrossRoads - 2000 will provide education, information, communication, and mentoring opportunities. Marshall University's community centered implementation of distance education will address many of the existing issues and problems of current computing/ teleconferencing projects. The integration of the video with the data systems into the same infrastructure will establish a cost effective integrated educational delivery system.

The use of compressed digital telecommunications will radically change the way people at the remote sites perceive their access to more urban developed centers and the larger world of information. This project will give immediate passageways for workforce development, in-service training, advanced degrees, and support for administrative and related activities. Distance education modules in a full array of subjects will be available to the public. A collaborative use of the trunk lines of communication established by this grant will provide students with broadband multi-media and Internet capabilities. In our specific environment the project is expected to:

Strengthen and further interconnect the existing multi-way compressed video and data networks in the state.
Provide relatively convenient access to courseware and information for various age levels and needs by partnering with Marshall University, The Marshall University Community College, The Southern West Virginia Community College System, K-12 schools in southwestern West Virginia, The Center for Rural Health, area hospitals, and libraries.
Provide relatively convenient access to the Internet and the variety of resources it provides.
Provide, specifically, opportunities for continuing education for educators, business professionals, paraprofessionals, and workforce employees.

These outputs would then provide increased education opportunities for rural based traditional and nontraditional students of a variety of ages. This should lead to increases in workforce preparation, and educational attainment that should lead to increased employability. This ultimate outcome, however, is necessarily limited based on job availability in the area and in the case of most West Virginia rural areas this is a very real limitation but a more employable workforce generally provides a much better environment for economic growth.

Additionally we would expect to:

Enhance the effectiveness and efficiencies of interdisciplinary rural teams at all locations. The video and data connectivity will strengthen the existing rural initiatives and stimulate new activities by providing the community with new collaboration opportunities that are only limited by the reach of the Internet.

Provide a strong communication mechanism of video and computer conferencing for administrative meetings, reducing travel costs and providing new information resources.

We would expect these outputs to then assist in establishing long-term community economic development activities, administrative cost containment and convenience in a sustainable manner.

Innovation

The principle innovation features of this project are: **(1) the flexibility and wealth of capabilities the integration of all of the following features brings in one maintainable system:** (a) An easy to use, low maintenance client workstation with custom software consolidating and simplifying the user interface; (b) A remotely maintained server environment that supplies traditional services to the cluster, but which are augmented to allow for the forward and store caching of the courseware, video, audio, and multimedia components; © ATM transmission capabilities in the WAN with quality of service features; (d) Video, audio, teleconferencing, and multimedia to the desktop; (e) A transparent forward and store capability to optimize bandwidth used at lower WAN speeds; (f) Integration to existing teleconferencing equipment and facilities; (g) Video on demand from the local server when precached either by request or on schedule; and (h) Client adaptable for use in the K-12, Vocational Technical, continuing education, and 2-year, 4-year, graduate, and professional higher education

environments, and (I) identification technology to enhance security and **(2) The cost effective manner in which these technologies can be implemented, utilized, sustained, and supported.**

The innovations are not cutting edge technologies but were not intended to be. The innovations here are the use of these technologies to tackle a fundamental systemic problem in this state of accessibility. The use of "advanced" technologies is expected to provide a cost effective alternative to transporting the student or instructor or the bricks and mortar alternative but at the same time provide a much more rich and interactive environment than the broadcast, i.e., "Sesame Street" approach.

Diffusion Potential

Many of the issues discussed above, (low college going rate, poorly educated workforce, place bound individuals, etc.) are very common to communities across the United States particularly in rural areas such as West Virginia. The approach in this project is adaptable to most, if not all, of these communities.

Alternative models have traditionally consisted of various combinations of the "driving instructor", the "talking head" or "Sesame Street" approach, or the isolated student interacting with a cost-effective (but not very human) WebPages not a mentor. *CrossRoads - 2000* presents a more human approach in its expanded video and audio capabilities in addition to the current web technologies. It is adaptable to many uses: community networking, traditional instruction, individualized instruction, health care, counseling, and access to public services. *CrossRoads - 2000* demonstrates a "cookie cutter approach" to the configuration of the learning clusters. Its use of "forward and store" caching compensates for low bandwidth (i.e., high cost services) or limited services. The identification technology promises increased security. The proposed model is sustainable and built on traditional payment for education, with the possibility of the consolidation of uses (and costs and bandwidth) within a community i.e. hub and tail circuits to consolidate library, schools, government, health, and business needs. The incorporation of videoconferencing into the system, coupled with the use of off-the-shelf components, make this an exceptional model for wide spread use.

Information gained in this project will be made available to others via a variety of means: a web site dedicated to the project, presentations at related conferences, and possible workshops if sufficient interest is expressed.

Project Feasibility

Technical Approach

The architecture diagrams in Appendix 2 depict the location and general function of the various components. The CrossRoads - 2000 learning cluster will be 10-30 pc based workstations with audio and video capability and 1 group system that will accommodate up to 6 in a small group session. Each workstation and the group system will be attached to a switched Ethernet port in a

LAN configuration. In addition, several servers will also connected in the same LAN. The servers will provide the traditional authentication, network area storage, applications, file, and print services but will additionally provide proxy and caching services for the cluster. Objects to be cached include video, multimedia presentations, some courseware, and general Internet caching.

In a first tier configuration, (typically a primary information node) the cluster is interconnected with the network by a LAN or high speed WAN (OC-3 ATM 155mb/sec) connection, in the second tier configuration (typically a secondary information node) by an intermediate speed WAN connection (DS-3 ATM 45mb/sec), and in the third tier configuration (typically the learning cluster node), by a lower speed WAN connection (DS-1 ATM 1.54mb/sec). In the fourth tier configuration the client workstation is interconnected with the cluster by a low speed WAN connection (56K or less) provided by the typical Internet Service Provider (a typical home user).

The associated information nodes have specific equipment and capabilities to support the learning clusters. The gatekeepers and Multipoint Control Units (MCU) will provide authentication, and bridging services to legitimate participants of a conference and other associated administrative tasks, as well as traditional bridging function for the H.323 clients. The H.320 to H.323 to H.321 gateways provides interoperability with existing videoconferencing equipment. The firewall/proxy servers at tier 1 and tier 2 sites provide the expected edge proxy and firewall services for those and the lower tier sites. The higher speed sites are expected to support the tier 4 clients and will need protection from the Internet.

Scalability

Scalability is inherent in the design. The components are for the most part off-the-shelf items and generally easily available. The system is designed to grow in small increments, such as the addition of extra bandwidth to a site, or additional workstations or small workgroup systems, or, in the case of the information nodes, the addition of new course content or additional video, courseware, or information servers. Obviously larger increments are also possible as in the case of the addition of new circuits and entire clusters, or new information nodes. The promise of IP and ATM multicast capability should lower bandwidth requirements for the synchronous deliveries. The caching and forward and store concept will allow for the installation of smaller initial clusters and for their incremental growth where network access costs are high. The network design also speaks to the issue of scalability in that the web of interconnected nodes of learning clusters and information nodes should tend to distribute itself over time as higher demand functions are moved down the hierarchy or lower tiers graduate to higher tiers and functionality as demand grows. While not expected, the system also allows for a scaling down of sites by relocating smaller components or lowering bandwidth needs. Temporary fine-tuning across clusters will be made on a periodic basis to accommodate peaks and toughs of demand at particular sites by the same relocation process.

The design ensures that the requirements for personnel at the cluster sites are minimized. The ability to remotely administer the servers at the cluster sites, the ability to push new software and

configurations to the sites, and the easily refreshable client design all speak to the ability to bring a cluster on line with minimal support overhead.

Interoperability

The strict adherence to standards (TCP/IP, ATM, Ethernet, MPOA, RSVP, H.320, H.323, H.321, etc.) and the use of off the shelf components virtually guarantees the interoperability, not only within the CrossRoads - 2000 network, but also allows for the incorporation and accommodation of other standard legacy (or new) equipment as other sites are added. (See Appendix 4)

Technical alternatives

Appendix 4 also discusses alternative technologies considered.

Maintenance

Maintenance of equipment in some of the remote sites planned for this project will present problems, but the use of off-the-shelf components should minimize the issues related to availability and parts acquisition. Our experience gives us confidence that remote network, server, and client administration, and remote network monitoring, combined with telephone support will allow for the resolution of the majority of problems without dispatching technical assistance. It is our intent to place at least the critical components on a maintenance contract and if required do self maintenance on the workstations. An opportunity might exist here for some community involvement and participation in the maintenance and upkeep of the learning cluster.

Applicant Qualifications

Key individuals from Marshall University are Arnold Miller, Jan Fox, and Allen Taylor. Miller and Taylor have worked as a team for almost 18 years to create Marshall's technological infrastructure to achieve a long line of "firsts" in the state (See Appendix 7). Jan Fox developed the Rural Health Net that has pulled West Virginia communities together for years. Together with John Buskey, who developed and runs the WV SatNet and George Beck who manages Bell Atlantic of WV's Strategic Initiatives the team brings many years of systems innovation experience to this project.

Marshall University provides serious commitment to this project. A position paper by former President J. Wade Gilley stressed four primary characteristics for which the university expects to be known: high quality undergraduate education; technological sophistication unmatched by any other university of its size and type in the nation; status as the prototypical *interactive university* in America; and sound management of human and financial resources. Resources are being provided to meet these goals. Of the six areas of emphasis, all are pertinent to the investigations, research and economic development programs of this project (See Appendix 6 for excerpt). A list of some of the major accomplishments of the university is also included in the Appendix 7 demonstrating its long-standing technical sophistication and capabilities.

Budget, Implementation Schedule and Timeline

The budget is $1,144,740. The request to NTIA/TOP for the 2000 budget cycle is for funding in the amount of $520,952. Specific justification for budgeted items is included in the budget narrative.

This project adds components to the principal information node supporting the learning clusters and implements 3 tier 3 clusters. The project timeline in Appendix 1details the individual tasks and their duration. Adequate time has been allowed for all steps in the process and it appears that the project can be completed within a 3-year period. Provision has been made in the schedule for training and developing documentation material, as well as the integration of an evaluation methodology.

Sustainability

Once the system is in place, student tuition fees will hopefully cover the costs of the educational organizations offering the education and allow for sharing in the cost of the infrastructure with the sponsoring sites. Teachers will be paid by their organizations. On site coordinators will be provided by the sponsoring site agencies. Contracts with organizations requesting continuing education for their employees could provide some funds. A usage fee by the sponsoring site agency could also used to subsidize the costs of the infrastructure.

Some telecommunication costs are initially covered by this grant. The involved institutions have budgeted ongoing telecommunication costs. The goal of the project is to deliver additional electronic resources and provide an administrative and technical infrastructure for faculty to realize long-term, productivity gains in teaching. Sometimes federally funded projects only work so long as the federal funding is present. This project recognizes education initiatives must lead to self-sustaining improvements. The goal for this project is to develop and share an organizational model, telecommunications infrastructure, courses, toolsets, and assessment tools. The goal is to build on earlier successes, and demonstrate through a further series of internal, innovative, education projects that this infrastructure system enhances access to a variety of educational opportunities.

Community Involvement

Partnerships

An extensive list of our ongoing partners in education in West Virginia is included in Appendix 8 with some specific letters of support in Appendix 1. Specifically for this project we have been building on our ongoing relationship with the K-12 community in our service area, particularly the high schools. This demonstrated by the success of our dual credit program in many local high schools. We expect a grant program from the WV legislature to provide some funding for technology to be placed in Hannan high school (Mason County) and would like to establish one of the learning clusters at this site. This school is a school in crisis and is being assisted by the Marshall University based Harless Center for Rural Educational Research and Development in improving its overall status. Bell Atlantic of West Virginia is another major partner in this endeavor. Bell Atlantic will design and install the statewide ATM network and grant the edge devices to selected sites. Although not counted in our budget, Bell Atlantic has made a significant investment in the telecommunications infrastructure of the state that has made the base technology for this project available. We are just beginning a relationship with the vocational technical schools as we roll out the Cisco Networking Academy. Working in conjunction with the Kanawha County Board of Education we will establish a learning cluster in the newly constructed Riverside High School in a rural section of that county. Both High School sites have a commitment to evening “community development” hours. And while not constituting a “community center” will provide some of that functionality. Marshall University is also working with a team from the WV correctional/judiciary and Bell Atlantic on the "Courtroom of the Future" project. Our involvement will be to provide educational opportunities to inmates and correctional staffs through the teleconferencing facilities at off peak hours. Our hope is to extend the CrossRoads - 2000 to the juvenile corrections population eventually. It is also expected that individuals from our Medical School will provide remote medicine services through the facilities. Another project participant is the International Union of Operating Engineers at their facility in Beckley, WV. We will be establishing a learning cluster there to provide some classes for Marshall University students as well as some union employees. They will also utilize the facility for their on-going union training purposes and general workforce development. They are providing the facility and a portion of the infrastructure and will be supporting the communications line.

Involvement of the Community

Marshall University prides itself as being the prototypical *interactive university*. We are in constant dialog with the communities of interest in our service area. We provide help and solutions to meet the needs of the community in a way that works for them, not just for academe or us in general. Because of this special relationship, we have on going information sharing activities. We do specific studies of the various communities at the behest of the communities themselves and often consult with community groups in areas they feel need to be strengthened.

Support for end users

Built into the timeline and budget are resources for the development of documentation, training, and user guides to assist in the support effort. One of the first steps toward a sustained activity

will be to identify a means of providing for site facilitators and coordinators. This might involve "scholarships" for interested students utilizing the sites, work-study and other community service opportunities. The principal source of higher-level technical support will still remain a remote activity. The ability to remotely administer the workstations, network, and servers will lessen the need for local technical support. We have been administrating networked laboratories and a large group of ISP customers for years and have been successful with this style of support.

Privacy

The implementation of a switched network is probably the one single effort that will contribute the most to the maintenance of privacy. Our use and abuse policy has spoken to this issue for a number of years and the number of reported incidences has been amazingly low. We are constantly on watch for "snoopers" on the network and other security problems and feel confident that extending these methods to this environment will be equally successful. The more open environment of the learning cluster will pose some interesting "opportunities" for investigation of the optimal furniture and organization to thwart the eavesdropper. There are not any significant technical barriers to the provision of adequate privacy. The cost, however, is usually the overriding factor in the implementation of a totally secure system and network. Our goal will be to provide as high a level of security and privacy as financially feasible. The introduction of ID technologies to the cluster will provide an increased level of security as it also provides information regarding its use and feasibility.

Reducing Disparities

Description and documentation of the disparities

West Virginia is the only state located entirely within poverty-stricken Appalachia. In 1995, unemployment in the 38 rural counties averaged 10.8 % (compared to a national average of 5.6%) and only 45.2% of persons 16 years of age an over were employed. Per capita income in those counties averaged only $14,393 in 1994 (see Appendix 9). The West Virginia college-going rate is the lowest in the nation West Virginia ranks fiftieth among the states in the preparation of its workforce for the new economy. West Virginia ranks forty-seventh in the nation in the proportion of its adult population at the lowest levels of literacy. Poverty and isolation keep these residents from recognizing the need for basic education let alone seeking access to higher education and general workforce development activities.

Strategies for overcoming barriers to access

Improvements in the infrastructure and dissemination of information, and instruction in how to use it, can afford rural communities more economic opportunities by providing them with better access to information, markets, and services such as business and technical assistance, medical care, and education. Recognizing this, the West Virginia Legislature in WVC 18B-1-5A (see Appendix 10) supported the effort to design a pilot program of delivering educational services via distance learning. In addition, Governor Cecil Underwood, in his State of the State address, said, “I have asked Bell Atlantic to establish a grant program to furnish special equipment to

higher education, health care and governmental institutions to help them use the network. Bell Atlantic has agreed to my request, thus greatly complementing its WORLD SCHOOL program, which links all West Virginia kindergarten through 12th grade public schools in its service area to the Internet." Our project builds on these commitments and will provide the very services envisioned.

Evaluation, Documentation, and Dissemination

Evaluation Plan

Assessment of the project will be three-fold to include the analysis of telecommunications requirements, project cost analysis and the impacts of the technology on learning, teaching, and costs (see Appendix 11). It is imperative to generate an architecture that permits full use of the technology employed. The project will use a qualified staff evaluator to do the evaluation of the project. This individual will be drawn from a department that is not directly involved with the project to maintain objectivity. The budget reflects financial and time resources and staff for a complete evaluation. In addition, the project director will submit quarterly narrative and financial reports to document progress. The evaluator and the Flashlight Project developed by Steve Ehrmann of the Annenberg/CPB Projects will be used in the learning assessment process with the responsibility to ensure independence of the internal assessments. The concern is less with producing some large and complex system than it is in keeping close touch with the needs of the customer and providing something helpful that fits smoothly into their workflow.

The notion of cost is multi-facetted. For starters, there is the cost to the student. The opportunity to stay at work or home and complete this program of study might be an enormous cost advantage to the person who would otherwise need to leave the workplace or home. Society benefits from better-educated, more employable citizens. Financial benefits the university may derive from the educational technology include savings in capital costs and operating expenses by offering an education in virtual space rather than in brick-and-mortar facilities; savings in information resources which are shared with other institutions through networks, and savings due to increased class sizes in higher-level courses because higher-quality education means higher retention rates. (Ehrmann, 1995):

Documentation Plan

The project will generate users guides and other material as it proceeds from test to pilot to production in the facilities. Faculty guides and a "recipe" book for the configuration, installation, testing, and placing in production of the learning clusters will also be produced. A guide for the technical support staff will also be valuable.

Information Dissemination Plan

The project will organize workshops around Digital Video Servers and bandwidth considerations. The workshop will include site information exchanges, commercial presentations, and a discussion of the results of the digital video experiences. Material produced

for the workshops will be available to interested organizations and publicized on the web page. Additionally, papers will be written for journals and presentations made at conferences.